Avian Studies for the Manistee National Forest Proposed Wind Energy Site: Summary of 2007 Field Seasons - Annual Report

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Introduction

Many areas along the shorelines of the Great Lake's possess winds adequate for the efficient generation of wind energy. These shorelines have also been documented to provide important habitat for wildlife including migratory songbirds and raptors. Shoreline areas have been suggested to be important as stopover sites for Neotropical migratory birds (Ewert 2006, Diehl et al. 2003) and as concentration or funneling areas migrating raptors which avoid crossing water. While predominantly forested, this area also includes unique dune habitats, nesting rare and endangered species such as Piping Plovers, Prairie Warblers, Cerulean Warblers, Northern Goshawks, Red-shouldered Hawks, Bald Eagles, and many other unique species and ecological communities. Additional Partners in Flight priority bird species that possibly nest in the area include Sedge Wren, Yellow Rail, Golden-winged Warbler, Wood Thrush, Veery, Rose-breasted Grosbeak, and Canada Warbler. During migration additional Partners in Flight priority bird species could also be present: Nelson's Sharp-tailed Sparrow, LeConte's Sparrow, Connecticut Warbler, and Kirtland's Warbler. Waterfowl (e.g., Common Loon) and birds of prey (e.g., Bald Eagle) use the area especially during breeding and migration seasons. Due to the potential for avian collisions with wind turbines the value of this research is heightened by the importance of this area to birds combined with the proposed wind energy development.

The research detailed in this report was conducted to determine the avian use of the area proposed for wind energy development in the Manistee National Forest as well as an adjacent reference where wind energy has not been proposed (Erickson et al. 2006). These data, in addition to the data collected in 2006 will help wind energy developers and resource managers to make appropriate decisions regarding the potential impacts to birds and the methods in which they might reduce those impacts. Many agencies and qualified scientists have reviewed the current study protocol for the preconstruction monitoring and provided valuable input. Employees of the USFWS (East Lansing, MI and Fort Snelling, MN offices), and the United States Forest Service (Manistee Ranger Station) have provided guidance.

Study Site and Methods

Study site and description

Research was conducted in Mason County, located in western Michigan, USA. The area is primarily forested with interspersed fallow fields, open wetlands, and forest openings as a result of timber harvest. Vegetation in this area is generally described as dry northern forests. The forest overstory typically includes components of jack pine (*Pinus banksiana*), white pine (*Pinus strobes*), aspen (*Populus* spp.), maple (*Acer* spp.), and oak (*Quercus* spp.) species with an understory of bracken fern (*Dennstaedtiaceae* spp.) and blueberry (*Vaccinium* spp.). With exception of the forested dune systems adjacent to the lakeshore the topography is predominantly flat sand lake plain (Albert 1995). The northern area proposed for wind energy development is an actively managed forest with regular timber harvests and red pine (*Pinus resinosa*) plantations (Fig.1). The more southern reference area is located in Nordhouse Dunes Wilderness Area (Fig. 2). Although not actively managed and without a maintained road system, this forested area also includes historic red pine plantations in its forest cover. Open leatherleaf (Chamaedaphne calyculata) wetland systems are present as well (cover photo).

Large bird surveys

We established a raptor and other large bird viewing station along the shoreline of Lake Michigan, west of the area proposed for wind development. This station provided the best possible viewshed of the proposed project site (Fig. 3). Following methods similar to those used by Hawkwatch International, we conducted 6-hour surveys at this station in April and May 2007 (Fig. 4). When conducting weather-dependent research, some flexibility in scheduling is needed and some surveys were missed due to inclement conditions.

During surveys each raptor, large bird, and sensitive status species was recorded in addition to the bird's flight path, flight direction, approximate flight altitude (lowest and highest flight altitude), whether it flew within the proposed project area, and the distance to each bird. Technicians used landmarks as reference when measuring distance to birds and flight altitude. Technicians also recorded the behavior and habitat use of each bird. Behavior categories were as follows: perched (PE), soaring (SO), flapping

(FL), flushed (FH), circle soaring (CS), hunting (HU), gliding (GL), and other (OT, noted in comments). Any comments or unusual observations were also noted. Weather data were collected in concert with large bird surveys; specifically, temperature, wind speed, wind direction, and cloud cover. The date, start, and end time of observation period, species or best possible identification, number of individuals, sex and age class, distance from plot center when first observed, closest distance, height above ground, activity, and habitat(s) were recorded.

Songbird surveys

In an effort to quantify the songbird use of both the proposed project areas and the nearby reference area, we collected data using methods similar to those used in studies estimating breeding bird densities (Reynolds 1995, Johnson et al. 2000, Howe et al. 1997). Forty-eight point count locations were established 400 m apart within the proposed project area and the surrounding area, 42 of which were accessible due to private property issues (Fig. 1). Thirty-seven point count locations were established in a similar grid pattern in the more southern reference area (Fig. 2). Spring surveys were conducted between April 14th and June 30, 2007 with an emphasis on locating and counting breeding and migrant birds. Fall surveys were conducted between September 28 and November 14, 2007 when the emphasis changed to locating and counting winter resident and migrating birds. Point count grids in both the proposed project area and the reference area were placed partially adjacent to the Lake Michigan shoreline. This allowed the potential to detect if migrant songbird use changes in relation to proximity to the shoreline, as has been suggested by migration scientists (Ewert 2006).

Surveys at point count sites were 5 min. long and initiated at sunrise. Technicians recorded the following data: date, survey start time, survey end time, temperature, wind speed, wind direction, cloud cover. Each individual bird observed during a survey was recorded by species, as well as the azimuth to the bird, method of detection, gender (if possible), distance from the observer, estimated flight height (if applicable), and other comments.

Fatality searches at meteorological monitoring tower

As part of the proposed wind project a meteorological monitoring tower was constructed approximately ¾ mile from the eastern shore of Lake Michigan. The tower is <61 m Above Ground Level (AGL), unlit, and supported by guy wires. Birds occasionally collide with tall structures during migration and daily movements, with taller (>300 m AGL), lit towers supported by guy wires involved in more significantly avian fatalities than shorter, unlit, guyless towers (Gehring et al. 2007). Most collisions with tall structures are thought to occur during migration; therefore, technicians searched the area under the meteorological monitoring tower for bird carcasses every 3 days during the peak of spring (April 1st and May 31st) migration. Technicians arrived at the tower in the mornings in an effort to prevent diurnal and crepuscular scavengers from removing carcasses. Using flagged, straight-line transects, technicians walked at a rate of 45-60 m per min and searched for carcasses within 5 m on either side of each transect (Gehring et al. 2007, Erickson et al. 2003). Transects covered a circular area under the tower with a radius equal to 90% the height of the tower. Bird carcasses were placed in plastic bags, and the following information was recorded: date, closest transect, distance from tower, azimuth to the tower, estimated number of days since death, and observer's name. Once bagged and labeled, carcasses were frozen for later identification and verification of species. Because technicians are unable to observe all bird carcasses under towers due to dense vegetation, observer fatigue, human error, scavenging by predators it was necessary to quantify each technician's observer detection rate. Observer detection trials were conducted with technicians once each field season. By placing 10 bird carcasses within the tower search area, I quantified the proportion of bird carcasses detected by each technician. For observer detection trials I used bird carcasses representing a range of sizes and colors, but they were predominantly Brown-headed Cowbirds painted to simulate the plumage of migrating songbirds. Bird carcasses used for observer detection trials were also painted with an "invisible" paint that glowed fluorescent colors when viewed under a black light. When analyzing the study data, the "invisible" paint prevented any confusion between birds that had collided with the towers and birds placed in the plots for observer detection trials. I maintained the appropriate USFWS and Michigan Department of Natural Resources (MDNR) permits.

Wintering Bald Eagle surveys

This region of Michigan has been documented to support wintering Bald Eagles (pers. comm. C. Schumacher, USFS). We conducted aerial surveys in the proposed project area and the surrounding areas in an effort to estimate the use by wintering Bald Eagles. Monthly surveys took place after the waterways of Michigan became frozen and Bald Eagles were more likely to be concentrated near open water. Seven 11-km long transects were flown each spaced 1 km apart and running approximately parallel to the boundaries of the area proposed for wind development (Fig. 5). We flew between 77 - 92 m above ground level, at approximately 145-160 km / hr (Fig. 6). Surveys were conducted 2 hrs after sunrise, when winds were less than 32 km / hr, no fresh snow was in the trees, and when skies were clear and without fog.

Results and Summary

Large bird surveys

During the 20 large bird surveys observers detected 1,082 large birds of 27 species. There was a mean of 54.1 birds detected per survey (9.3 birds / hour) (Table 1). The waterbird (e.g., gulls) group was the most abundant of the bird groups per survey (22.0 birds / survey, 3.8 birds / hour; Fig. 7), followed by raptors (20.3 birds / survey, 3.5 birds / hour, Fig. 8), waterfowl (9.9 birds / survey, 1.7 birds / hour, Fig. 9), and corvids (1.95 birds / survey, 0.3 birds / hour, Fig.10) (Table 2). Raptors were the most frequently occurring species group (62.2% of surveys) (Table 2). The most common raptor species observed was the Turkey Vulture (176 birds) which was observed throughout the survey period (Table 3, Fig.11). The Sharp-shinned Hawk was the second most common species (83 birds) and was most common in late April (Table 3, Fig.12). The Red-tailed Hawk (40 birds), Northern Harrier (22 birds), and Red-shouldered Hawk (15 birds) were also observed in relatively high frequency (Table 3, Figs.13-25). Twelve Bald Eagles were observed during surveys (Table 3, Fig.16).

The mean flight altitude of raptors was 205.0 m. Assuming the wind turbine rotor-swept area (RSA) would be 26 – 74 m above the ground, 1% of birds flew below the RSA, 23% within the RSA, and 76% above the RSA. Migrating raptors generally followed very similar flight paths along the predominantly forested shoreline dune

system running north and south, with greater abundance to the east of the observation site than to the west. However, waterfowl and waterbirds were more abundant to the west of the observation site over, in and near Lake Michigan. Fifty-nine percent of raptors flew over forested areas (including forested dunes), 16% over the unforested dunes, 4% over the beach habitats, and 3% over open/shrub habitats.

Table 1. Avian abundance and richness in Mason County, MI in and around a site proposed for the development of wind energy. Data were collected in the spring of 2007 at a large bird survey site.

	Large Bird Survey
No. Species	27
Mean No. Species / Survey	1.4
Mean No. Species / Hour	0.2
Mean No. Birds / Survey	54.1
Mean No. Birds / Hour	9.3

Table 2. Mean bird abundance and percent frequency of occurrence in Mason County, MI in and around a site proposed for the development of wind energy. Data were collected in the spring of 2007 at a large bird survey site.

Group	Mean Abundance [a]	% Freq. of Occurrence [b]
Waterbirds	22.0	80.0%
Waterfowl	9.9	30.0%
Raptors	20.3	85.0%
Corvids	2.0	15.0%

[a] Mean Abundance = mean number of individuals observed per survey
[b] % Freq. of Occurrence = percent of all surveys where bird group was observed

Table 3. Avian abundance and richness in Mason County, MI in and around a site proposed for the development of wind energy. Data were collected in the spring of 2007 at a large bird survey site.

Species	No. Bird
American Kestrel	1
Bald Eagle	12
Broad-winged Hawk	3
Cooper's Hawk	9
Golden Eagle	1
Merlin	11
Northern Goshawk	3
Northern Harrier	22
Osprey	5
Peregrine Falcon	2
Red-tailed Hawk	40
Red-shouldered Hawk	15
Rough-legged Hawk	2
Sharp-shinned Hawk	83
Turkey Vulture	176
Unknown eagle	2
Unknown large raptor	7
Unknown med. raptor	4
Unknown small raptor	8

Songbird surveys

We completed a mean of 9 visits to each point count in the reference and a mean of 12 visits to each point count in the proposed project area between April 14th and June 30th, 2007. In the fall, between September 28th and November 14th, 2007 we visited the point counts in the reference area and proposed project area a mean of 5 times and 15 times, respectively. High winds prevented data collection on many mornings. However, warm weather allowed many migrants to remain in the area longer then typical falls; thereby, extended the migration period and the data collection opportunities.

Surveys of point count stations detected 7,137 birds of 115 species in the spring of 2007 and 4,503 birds of 69 species in the fall of 2007 (Table 4, Appendix A.). We detected a mean of 8.4 birds per point count visit (mean of 6.1 species / survey) in the spring and 5.8 birds per point count visit (mean of 3.3 species / survey) in the fall of 2007 (Table 4). The reference area and the proposed project area had similar bird densities and

a similar number of species detected at each point. In the spring of 2007 the mean number of birds detected at each point count visit was 8.1 individuals with a mean of 5.8 species in the reference area and 8.7 individuals with 6.3 species in the proposed project area. Similarly, in the fall of 2007 the mean number of birds detected at each point count visit was 5.9 individuals and a mean of 3.4 species in the reference area and 5.8 individuals and 3.2 species in the proposed project area. The decrease in bird density and species diversity between spring and fall reflects the exodus migrants from the region. This consistency between the reference area and the proposed project area suggests that they are adequately matched for the purposes of this study.

In the spring the 3 most abundant bird groups per survey were the warblers (2.1 birds / survey), followed by vireos (1.4 birds / survey), and flycatchers (0.6 birds / survey) (Table 5). In the fall the 3 most abundant bird groups per survey were the chickadees/nuthatches and corvids which both had a mean of 1.2 birds / survey, followed by woodpeckers (0.4 birds / survey) (Table 6). The warbler group was present most frequently (96.8% of surveys) in the spring and the corvid group was most frequently occurring in the fall (62.5% of surveys) (Tables 5 and 6). These patterns support the changes typically observed in more northern climates, such as Michigan. Most bird species, such as the warblers, vireos, and flycatchers migrate to areas with less inclement winter weather; however, species such as the Black-capped Chickadee, White-breasted Nuthatch, Blue Jay, and American Crow remain in the area throughout the year.

During their night migrations songbirds have been documented to fly in large flocks over both land and the Great Lakes (Diehl et al 2003). However, at dawn when they are preparing to land, rest and refuel those over bodies of water are forced to navigate to the closest shoreline. This supports the suggestion that shoreline habitats are critical "stopover" sites for migrating songbirds (Ewert 2006). Using linear regression, I compared the numbers of migrants and the numbers of species at each point count to the distance from the Lake Michigan shoreline. I found no significant relationships except for in spring 2007 data where I found a significant relationship between the numbers of species and the distance to the shoreline ($p \leq 0.01$, $r^2=0.04$). It is possible that individual days may have significantly more birds closer to the shoreline; however, this relationship may be undetectable when the remaining days are included in the analysis.

Table 4. Avian abundance and richness in Mason County, MI in and around a site proposed for the development of wind energy. Data were collected in the spring and fall 2006 point counts sites.

	Spring Point Count	Fall Point Count
No. Species	115	69
Mean No./Survey Project Area	8.7	5.8
Mean No./Survey Reference Area	8.1	5.9
Mean No. Species/Survey Project Area	6.3	3.2
Mean No. Species/Survey Reference Area	5.8	3.4

Table 5. Mean bird abundance and percent frequency of occurrence in Mason County, MI in and around a site proposed for the development of wind energy. Data were collected in the spring of 2007 at a point count sites.

Group	Mean Abundance [a]	% Freq. of Occurrence [b]
Blackbirds	0.6	21.0
Chickadees/Nuthatches	0.5	36.3
Corvids	0.3	22.1
Cuckoos	0.1	7.4
Doves	0.1	10.3
Finches/Buntings	0.4	36.4
Flycatchers	0.7	59.3
Galliformes	0.02	1.8
Goatsuckers	0.00	0.2
Grosbeaks	0.1	8.2
Gulls	0.0	0.5
Kinglet	0.1	3.4
Other Passerines	0.2	17.3
Raptors	0.04	3.4
Shorebird	0.01	0.7
Sparrows	0.5	38.8
Tanagers	0.3	29.8
Thrushes	0.5	40.7
Vireos	1.4	83.8
Warblers	2.1	96.8
Waterbirds	0.1	1.9
Woodpeckers	0.3	19.1

[a] Mean Abundance = mean number of individuals observed per survey
[b] % Freq. of Occurrence = percent of all surveys where bird group was observed

Table 6. Mean bird abundance and percent frequency of occurrence in Mason County, MI in and around a site proposed for the development of wind energy. Data were collected in the fall of 2007 at a point count stations.

Group	Mean Abundance [a]	% Freq. of Occurrence [b]
Blackbirds	0.2	1.0
Chickadees/Nuthatches	1.2	58.8
Corvids	1.2	62.5
Cuckoos	0.0	0.0
Doves	0.0	0.0
Finches/Buntings	0.6	28.3
Flycatchers	0.0	0.0
Galliformes	0.03	2.8
Goatsuckers	0.0	0.0
Grosbeaks	0.07	2.2
Gulls	0.1	0.5
Kinglet	0.4	23.3
Other Passerines	0.6	27.4
Raptors	0.03	2.3
Shorebird	0.0	0.3
Sparrows	0.1	5.5
Tanagers	0.0	0.0
Thrushes	0.4	19.9
Vireos	0.0	0.0
Warblers	0.1	8.8
Waterbirds	0.4	2.7
Woodpeckers	0.4	29.2

[a] Mean Abundance = mean number of individuals observed per survey
[b] % Freq. of Occurrence = percent of all surveys where bird group was observed

Fatality searches at meteorological monitoring tower

During the carcass searches conducted during the spring migration season at the meteorological monitoring we found 3 birds determined to be killed during the study period (Table 7). The observer detection trails quantified that technicians found 70% of the carcasses at the site. This relatively high rate of detection is likely due to the small search area preventing observer fatigue and sparse vegetation allowing high visibility. Additional field seasons of data collection will provide additional information regarding the risk to birds presented by this meteorological tower. It is important to note that the number of avian fatalities at this unlit structure will not necessarily be indicative of the

number of fatalities at any subsequent turbine structures. In addition, turbines are frequently a source of fatality for bats in addition to birds (Johnson and Arnett 2004), while bats are rarely found under communication towers or meteorological towers. To accurately estimate bird and bat fatalities at turbines carcass searches would need to be conducted post-construction.

Table 7. Avian fatalities documented at meteorological monitoring tower in Mason County, MI during the peak of songbird migration in the spring 2007.

Bird Species[a]	No. carcasses found
Eastern Wood-pewee	1
Eastern Meadowlark	1
Yellow-rumped Warbler	1

[a] names of birds follow the *AOU Check-list of North American Birds*

Wintering Bald Eagle surveys

Michigan was unusually warm in the early winter season, resulting in lakes and rivers remaining unfrozen until February 2007. During the February survey (23 Feb 2007), we did not detect any Bald Eagles or other raptors within the survey area (Table 8). However, during the March survey (20 March 2007) we detected 1 Bald Eagle soaring within the survey area as well as 3 additional species of raptor (Table 8, Fig. 26). Within 1 mile south of the aerial survey area we observed 1 Bald Eagle nest with an adult present and 1 juvenile Bald Eagle flying nearby.

The United States Forest Service provided information on several Bald Eagle nests in the area (Fig. 26). These and other data should be incorporated into evaluations of the site regarding the risk of wind energy development to Bald Eagles.

Table 8. Raptors observed within the Mason County, Michigan survey area during aerial surveys in February and March 2007 at a site proposed for the development of wind energy.

Survey Date	Raptor Species	No. of Individuals
23 February	N/A	N/A
20 March	Bald Eagle	1
20 March	Red-tailed Hawk	3
20 March	Northern Harrier	2
20 March	Rough-legged Hawk	1
Total		7

Additional surveys to be conducted in 2008

Upon completion of the proposed turbine site plan in April 2008, we will complete localized surveys for rare and special species that could potentially be negatively impacted by the proposed project. Special consideration will be provided for Copper's Hawk, Northern Goshawk, Red-shouldered Hawk, Cerulean Warbler, Hooded Warbler, Prairie Warbler, Blanding's turtle, Eastern box turtle, Eastern massasauga and wood turtle. We will use accepted agency protocols such as: broadcast call surveys and transect searches when quantifying their presence in the study area. Michigan Natural Features Inventory biologists possess a wealth of experience surveying for the presence of these rare and declining species.

Additional carcass searches will be conducted at the meteorological monitoring tower as well as an additional tower recently erected at the site.

Acknowledgments

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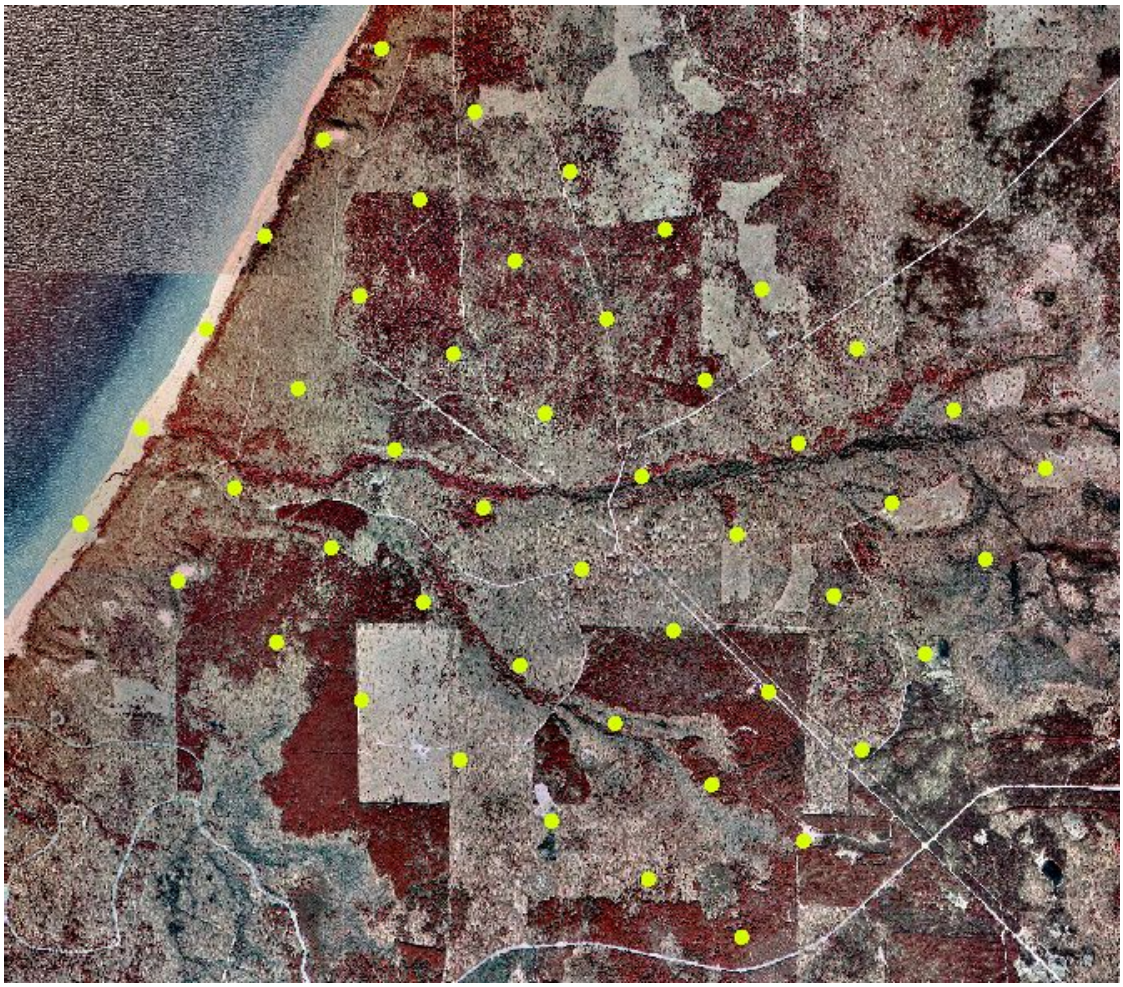

Figure 1. Point count sites were established 400 m apart in Mason County, Michigan, in and around a site proposed for wind energy development. These sites were surveyed in April, May, June, September, October, and November 2007 for bird use.

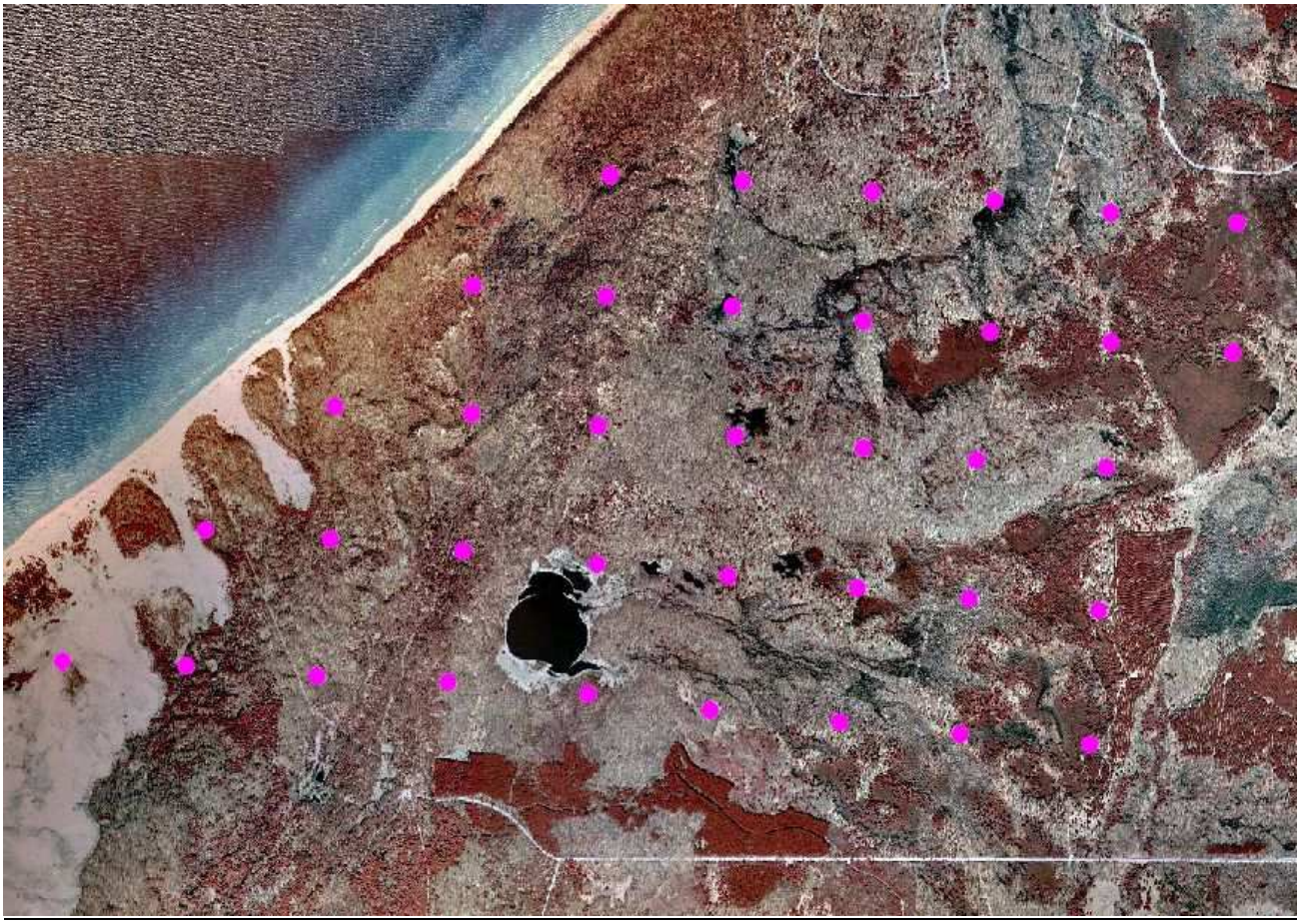

Figure 2. Point count sites were established 400 m apart in Mason County, Michigan, in a reference site established for a proposed wind energy development project. These sites were surveyed in April, May, June, September, October, and November 2007 for bird use.

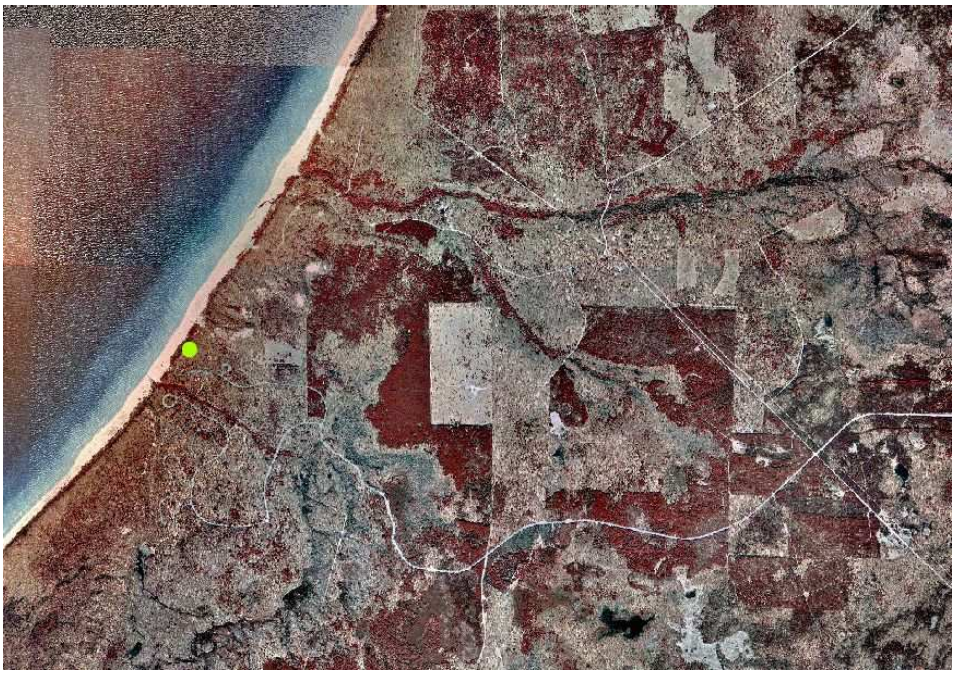

Figure 3. Large bird surveys were conducted in Mason County, Michigan, near a site proposed for wind energy development. The site was surveyed in April and May 2007.

Figure 4. An observation tower was used to conduct large bird surveys in Mason County, Michigan, near a site proposed for wind energy development. The site was surveyed in April and May 2007.

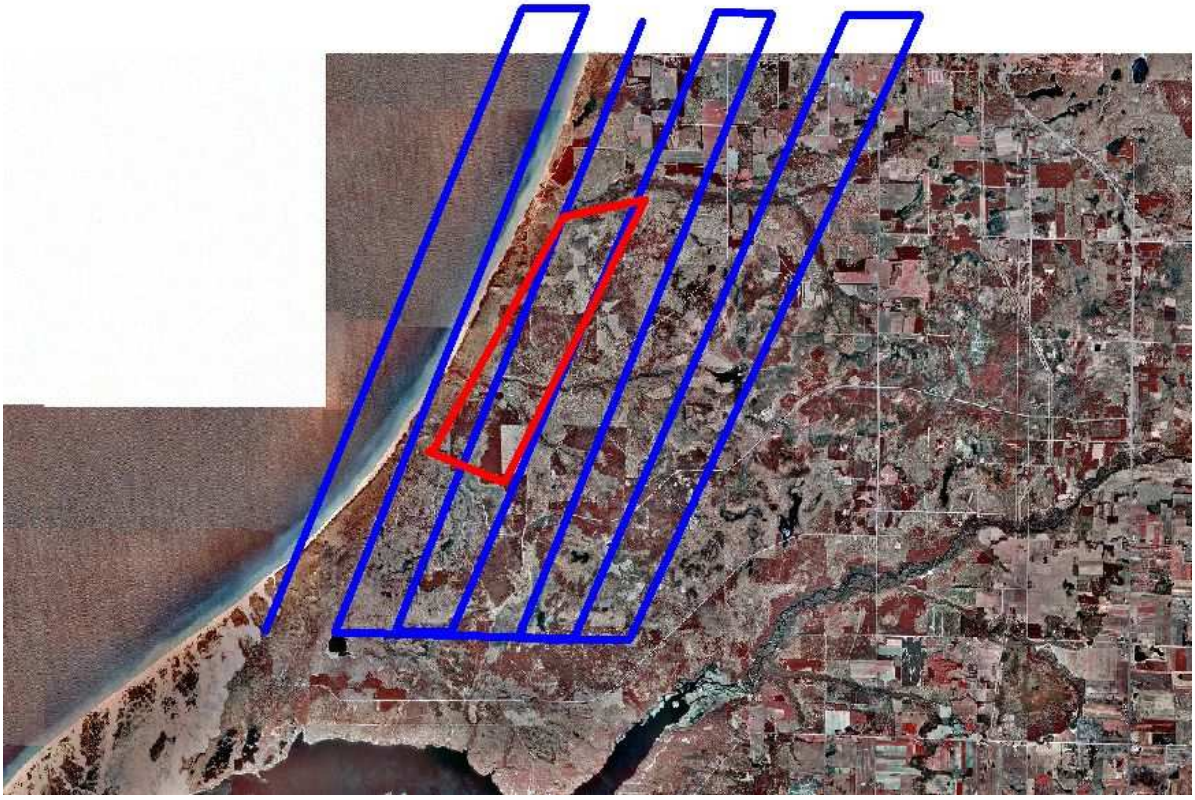

Figure 5. Aerial winter Bald Eagle surveys (blue) were conducted in February and March 2007 in Mason County, Michigan, near a site proposed for wind energy development (red).

Figure 6. A small aircraft was used for aerial winter Bald Eagle surveys were conducted in February and March 2007 in Mason County, Michigan, near a site proposed for wind energy development.

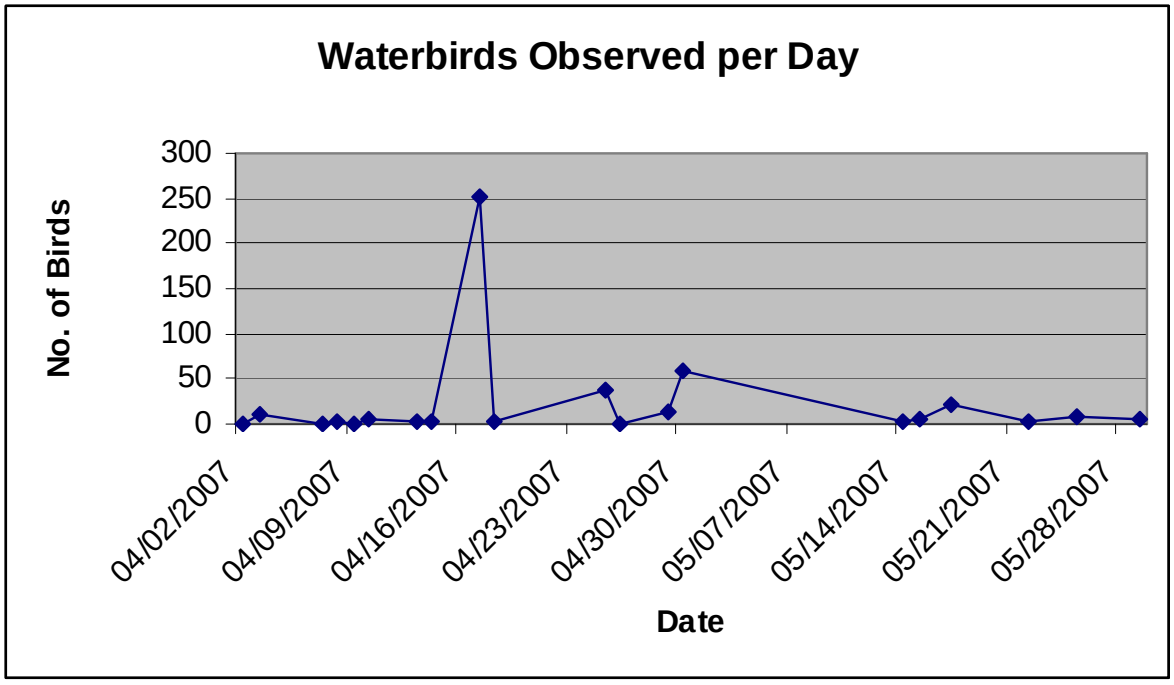

Figure 7. Large bird surveys were conducted in Mason County, Michigan and the numbers of waterbirds observed were quantified by survey day. Surveys were conducted in April and May 2007.

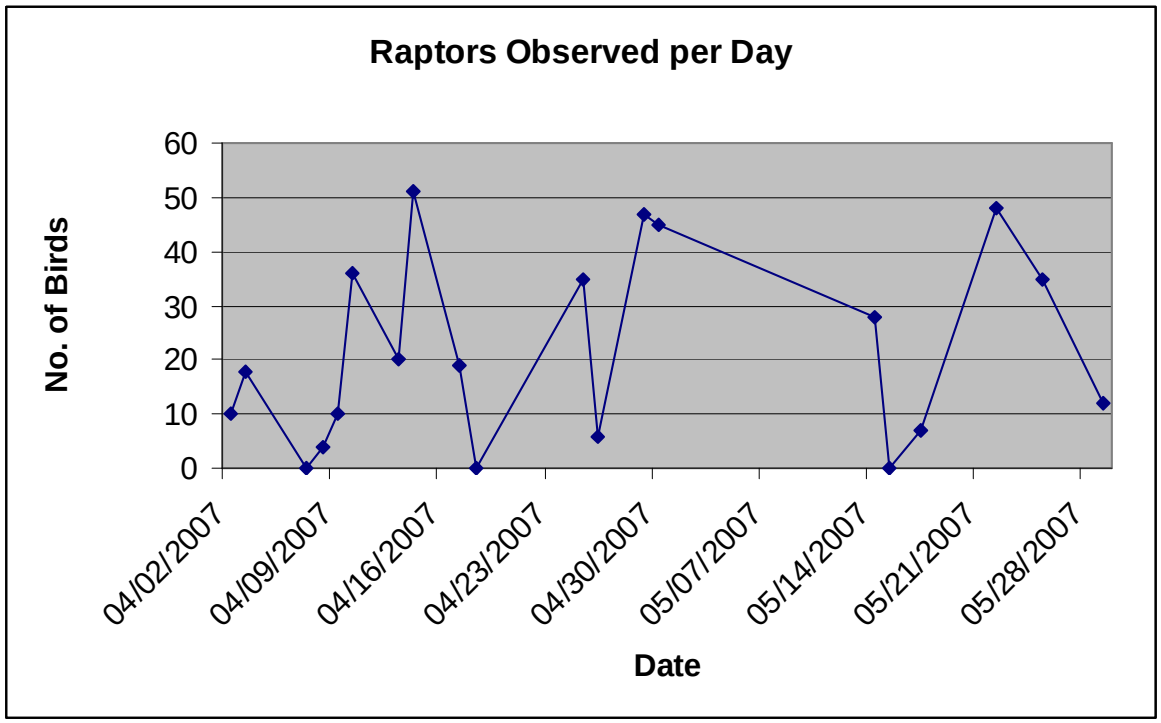

Figure 8. Large bird surveys were conducted in Mason County, Michigan and the numbers of raptors observed were quantified by survey day. Surveys were conducted in April and May 2007.

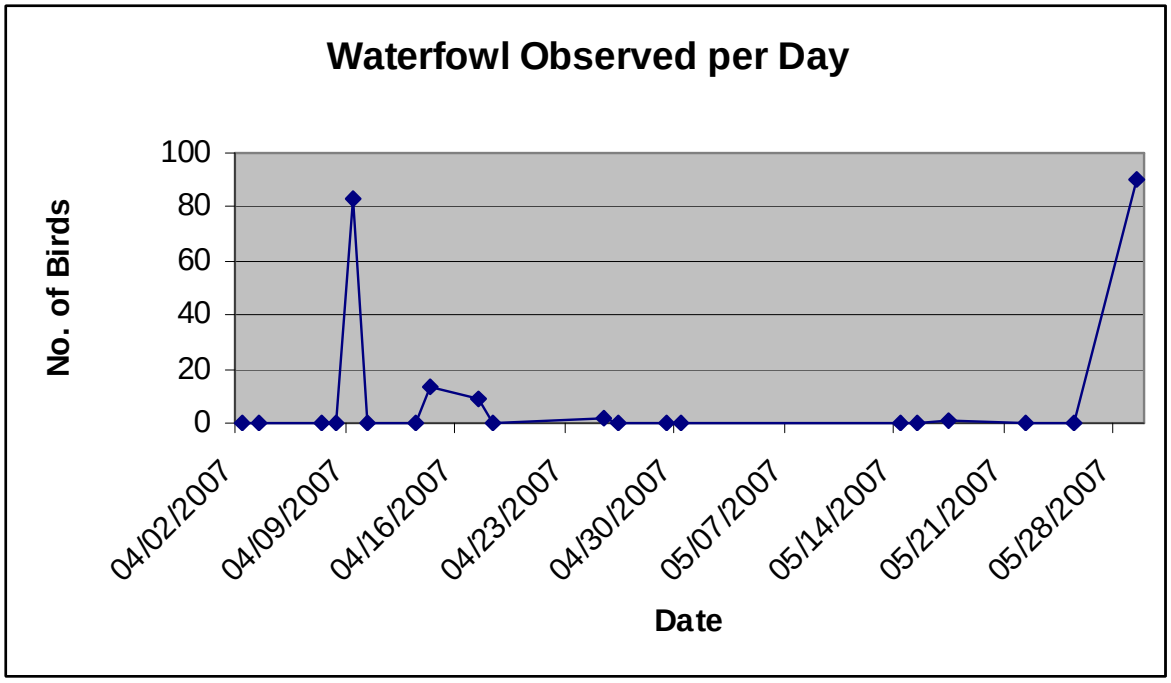

Figure 9. Large bird surveys were conducted in Mason County, Michigan and the numbers of waterfowl observed were quantified by survey day. Surveys were conducted in April and May 2007.

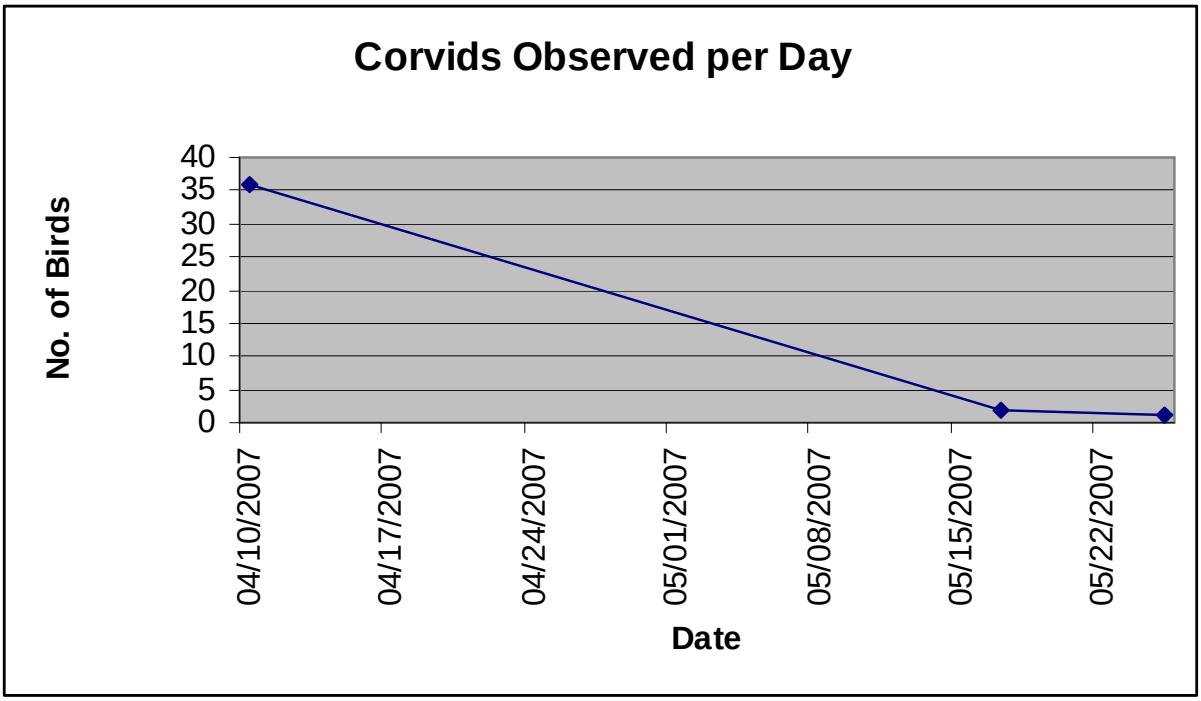

Figure 10. Large bird surveys were conducted in Mason County, Michigan and the numbers of corvids observed were quantified by survey day. Surveys were conducted in April and May 2007.

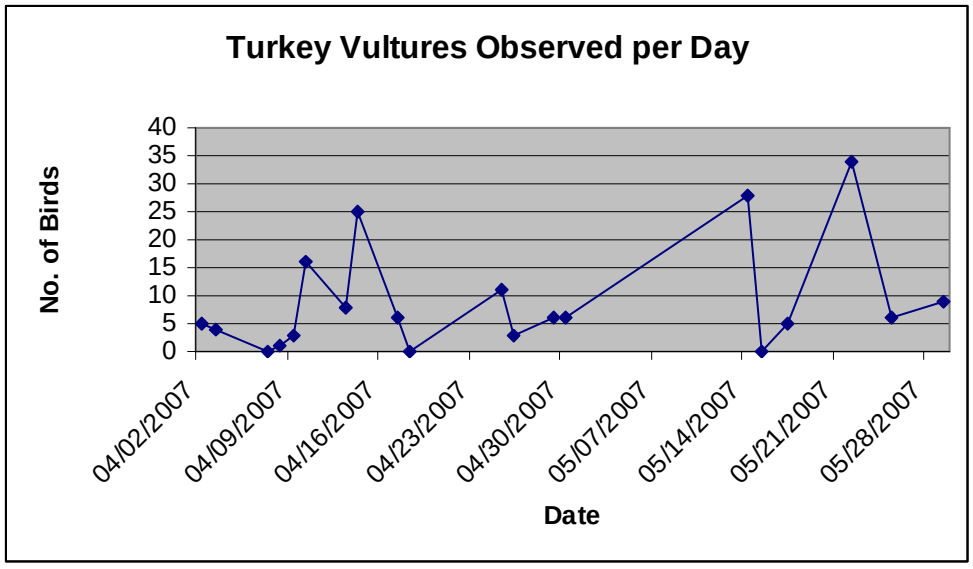

Figure 11. Large bird surveys were conducted in Mason County, Michigan and the numbers of Turkey Vultures observed were quantified by survey day. Surveys were conducted in April and May 2007.

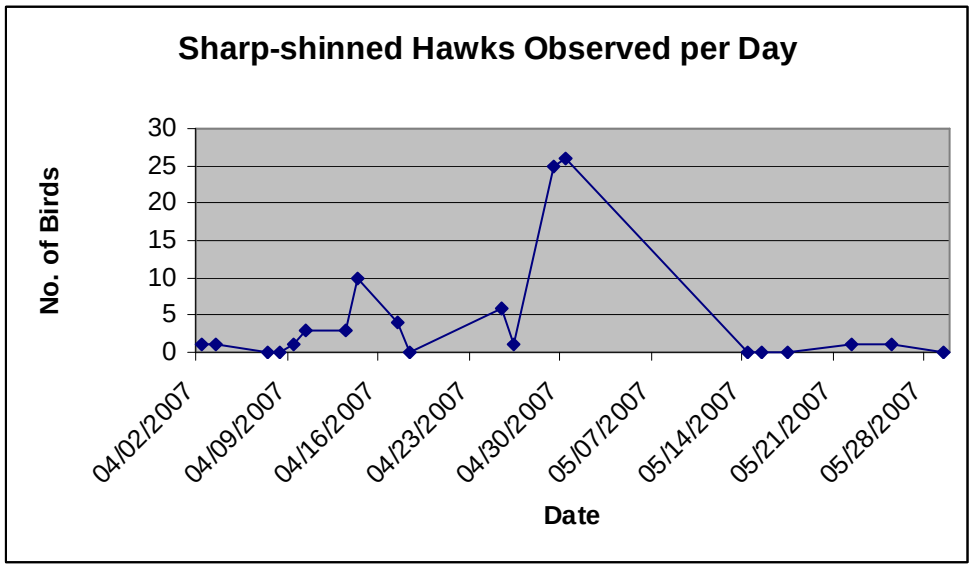

Figure 12. Large bird surveys were conducted in Mason County, Michigan and the numbers of Sharp-shinned Hawks observed were quantified by survey day. Surveys were conducted in April and May 2007.

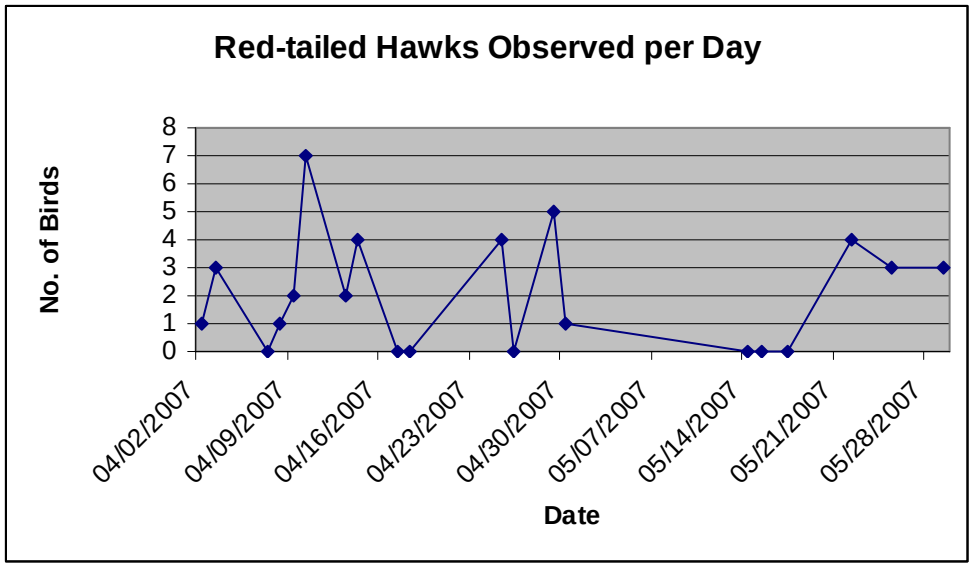

Figure 13. Large bird surveys were conducted in Mason County, Michigan and the numbers of Red-tailed Hawks observed were quantified by survey day. Surveys were conducted in April and May 2007.

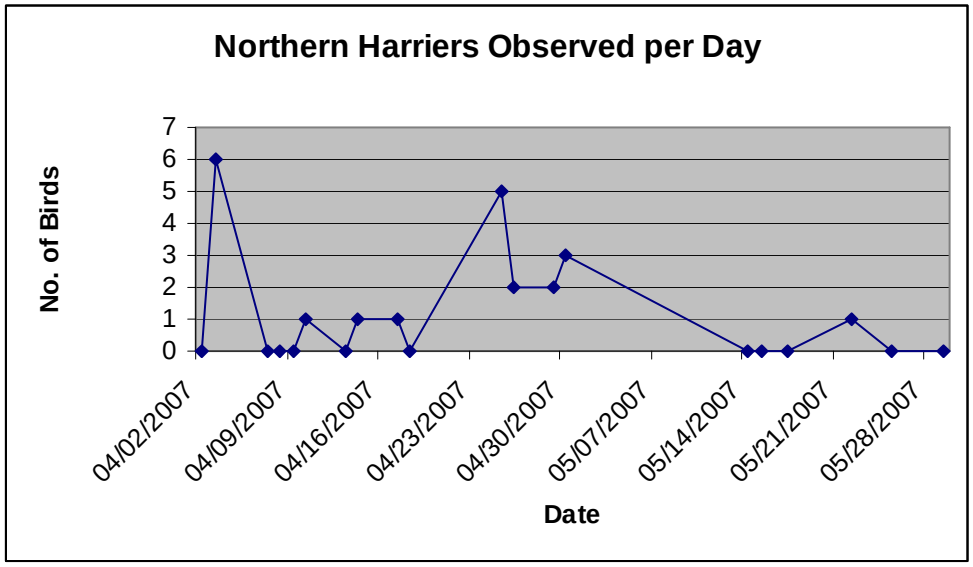

Figure 14. Large bird surveys were conducted in Mason County, Michigan and the numbers of Northern Harriers observed were quantified by survey day. Surveys were conducted in April and May 2007.

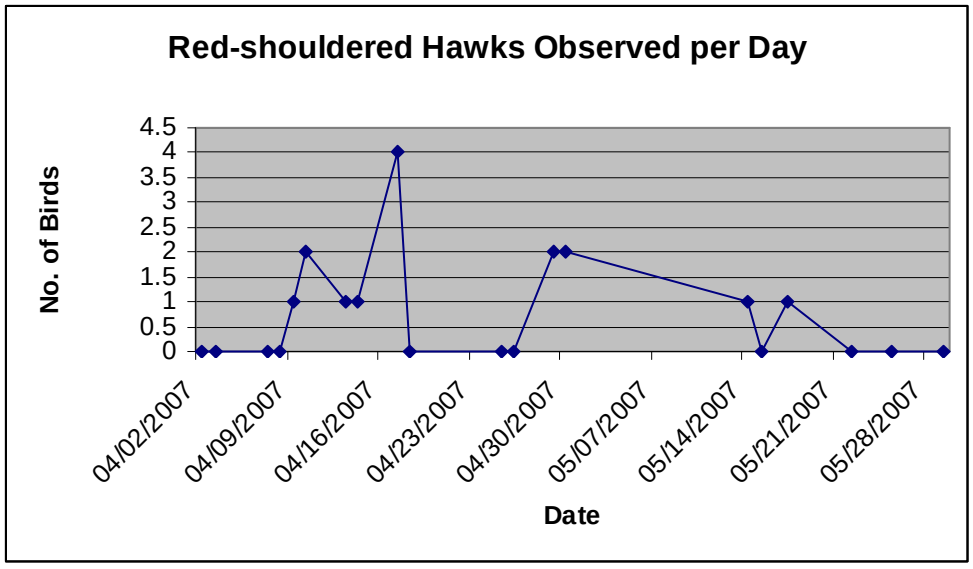

Figure 15. Large bird surveys were conducted in Mason County, Michigan and the numbers of Red-shouldered Hawks observed were quantified by survey day. Surveys were conducted in April and May 2007.

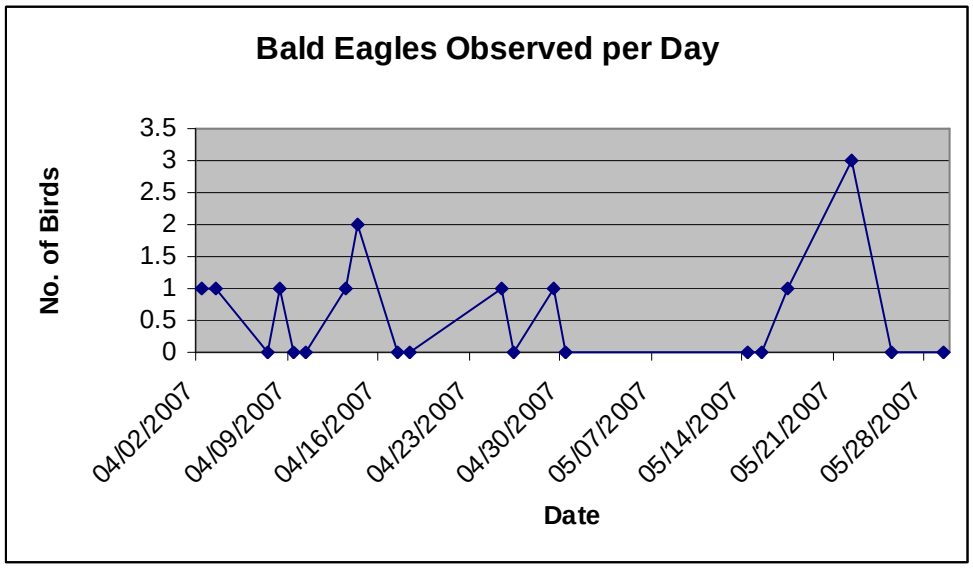

Figure 16. Large bird surveys were conducted in Mason County, Michigan and the numbers of Bald Eagles observed were quantified by survey day. Surveys were conducted in April and May 2007.

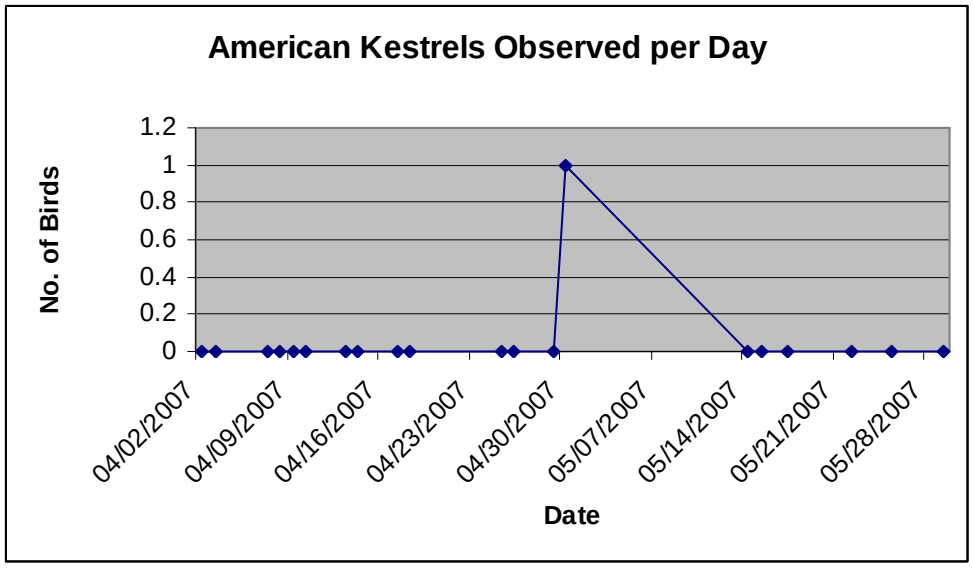

Figure 16. Large bird surveys were conducted in Mason County, Michigan and the numbers of American Kestrels observed were quantified by survey day. Surveys were conducted in April and May 2007.

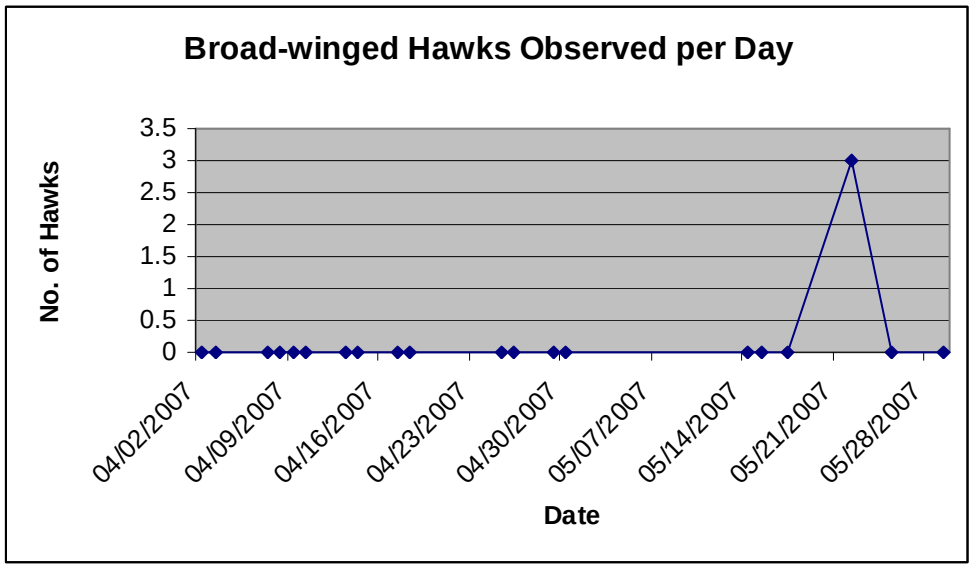

Figure 18. Large bird surveys were conducted in Mason County, Michigan and the numbers of Broad-winged Hawks observed were quantified by survey day. Surveys were conducted in April and May 2007.

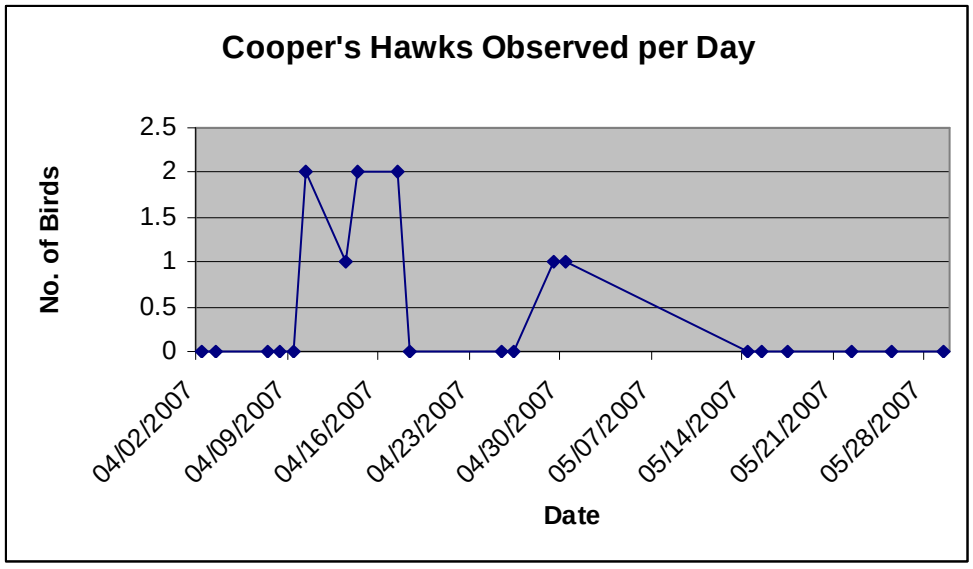

Figure 19. Large bird surveys were conducted in Mason County, Michigan and the numbers of Cooper's Hawks observed were quantified by survey day. Surveys were conducted in April and May 2007.

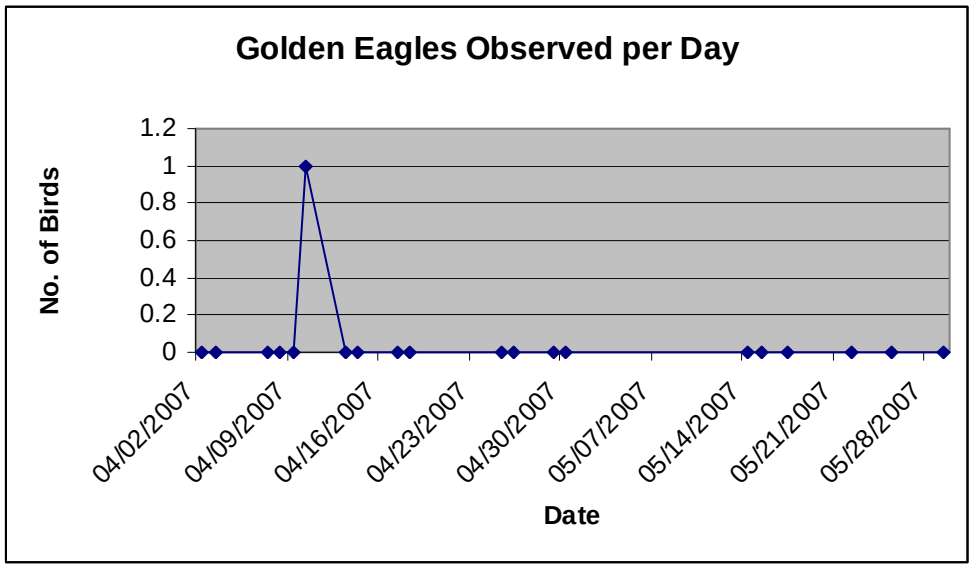

Figure 20. Large bird surveys were conducted in Mason County, Michigan and the numbers of Golden Eagles observed were quantified by survey day. Surveys were conducted in April and May 2007.

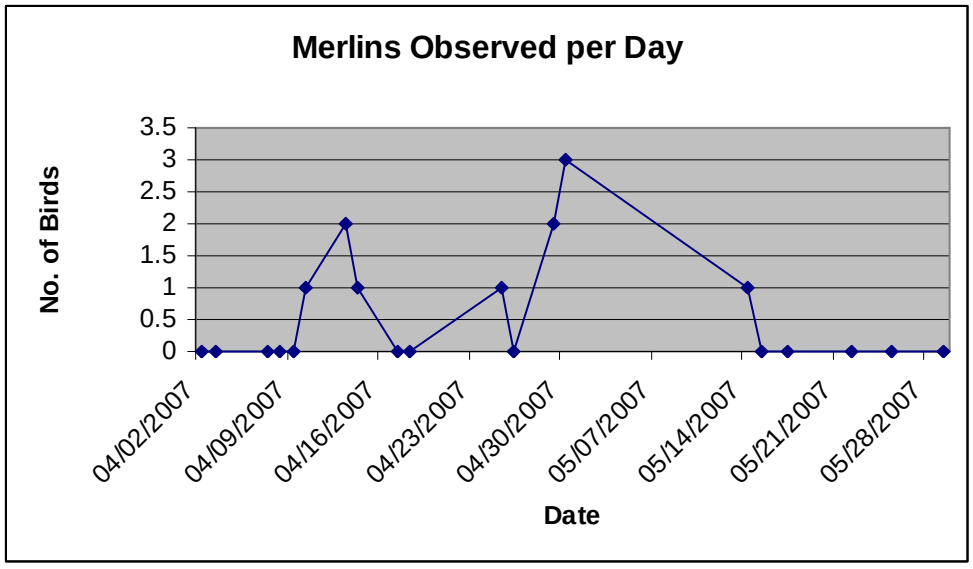

Figure 21. Large bird surveys were conducted in Mason County, Michigan and the numbers of Merlins observed were quantified by survey day. Surveys were conducted in April and May 2007.

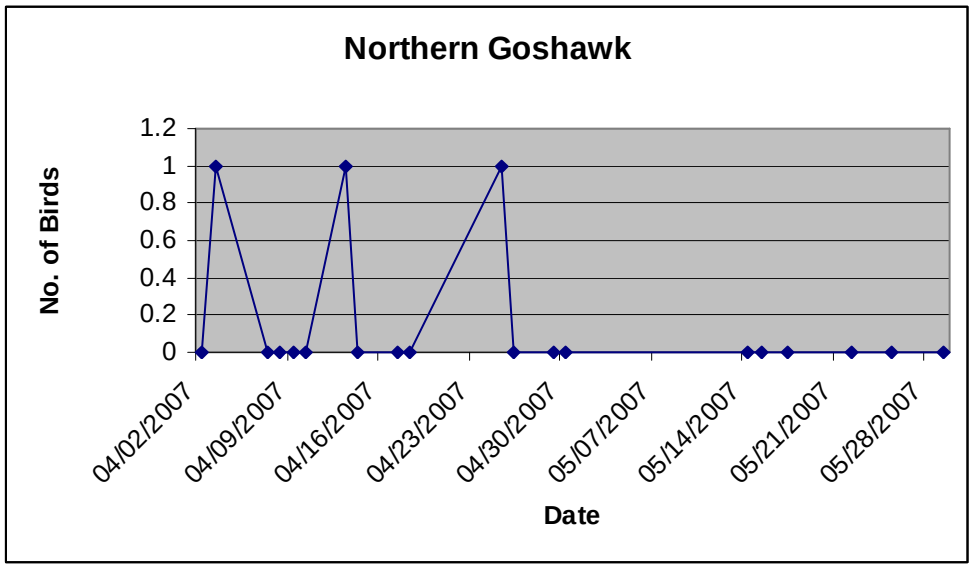

Figure 22. Large bird surveys were conducted in Mason County, Michigan and the numbers of Northern Goshawks observed were quantified by survey day. Surveys were conducted in April and May 2007.

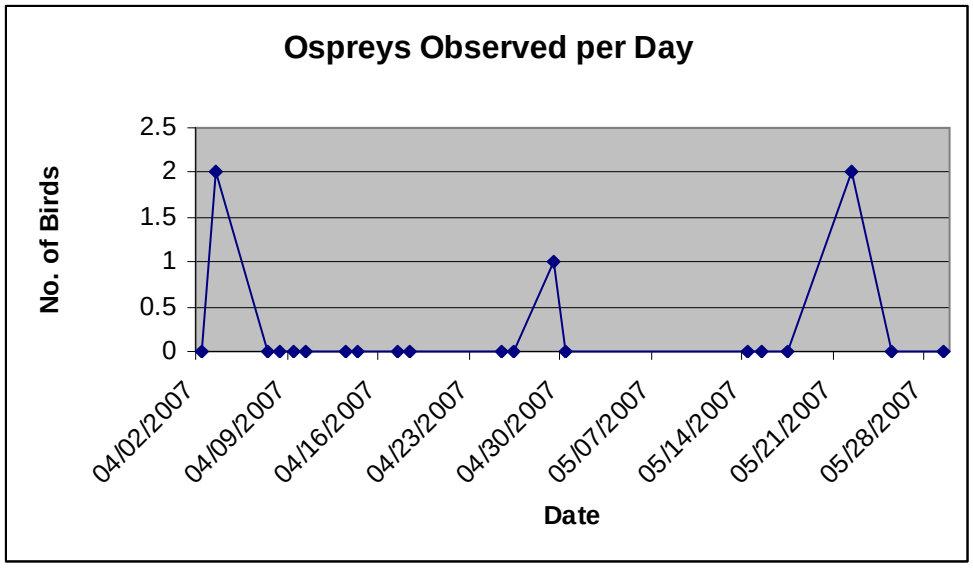

Figure 23. Large bird surveys were conducted in Mason County, Michigan and the numbers of Osprey observed were quantified by survey day. Surveys were conducted in April and May 2007.

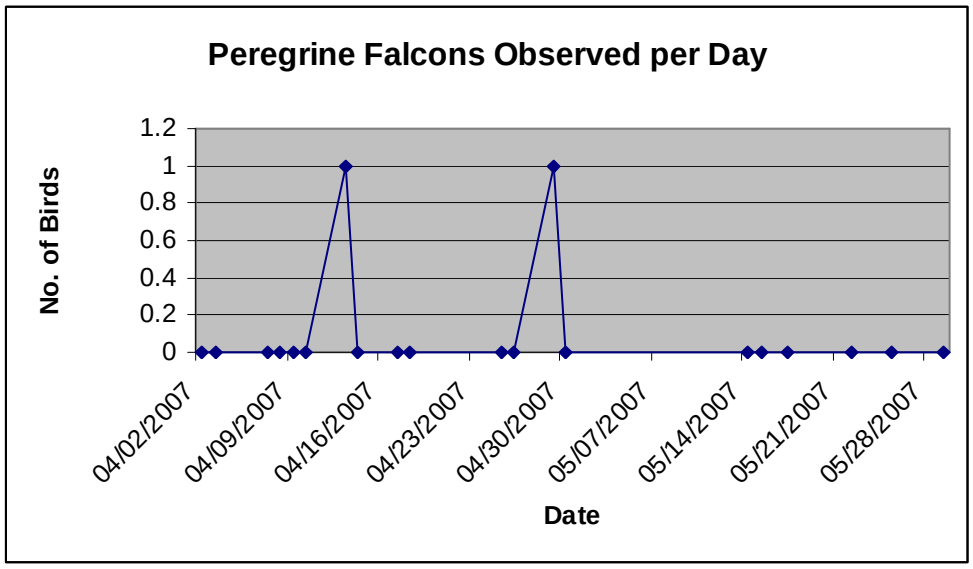

Figure 24. Large bird surveys were conducted in Mason County, Michigan and the numbers of Peregrine Falcons observed were quantified by survey day. Surveys were conducted in April and May 2007.

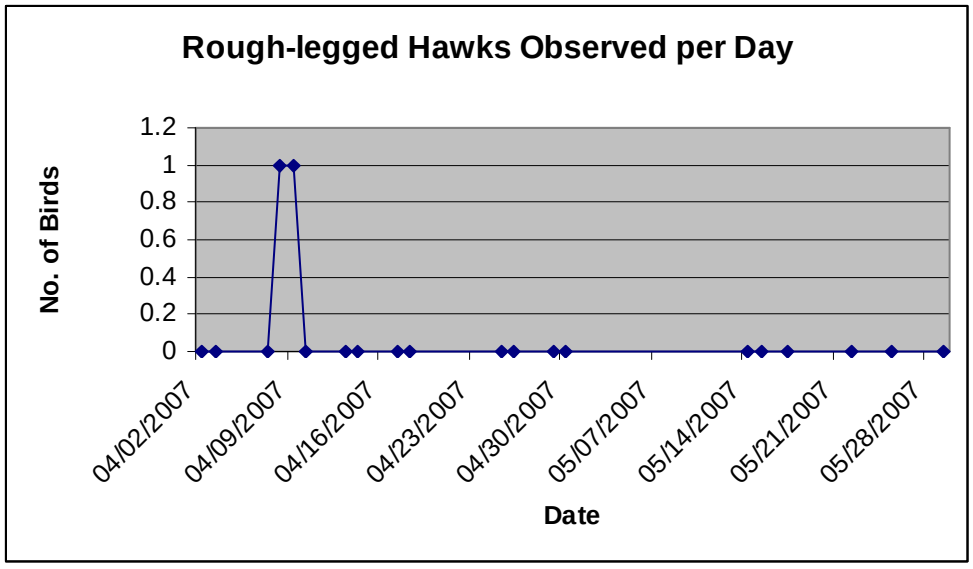

Figure 25. Large bird surveys were conducted in Mason County, Michigan and the numbers of Rough-legged Hawks observed were quantified by survey day. Surveys were conducted in April and May 2007.

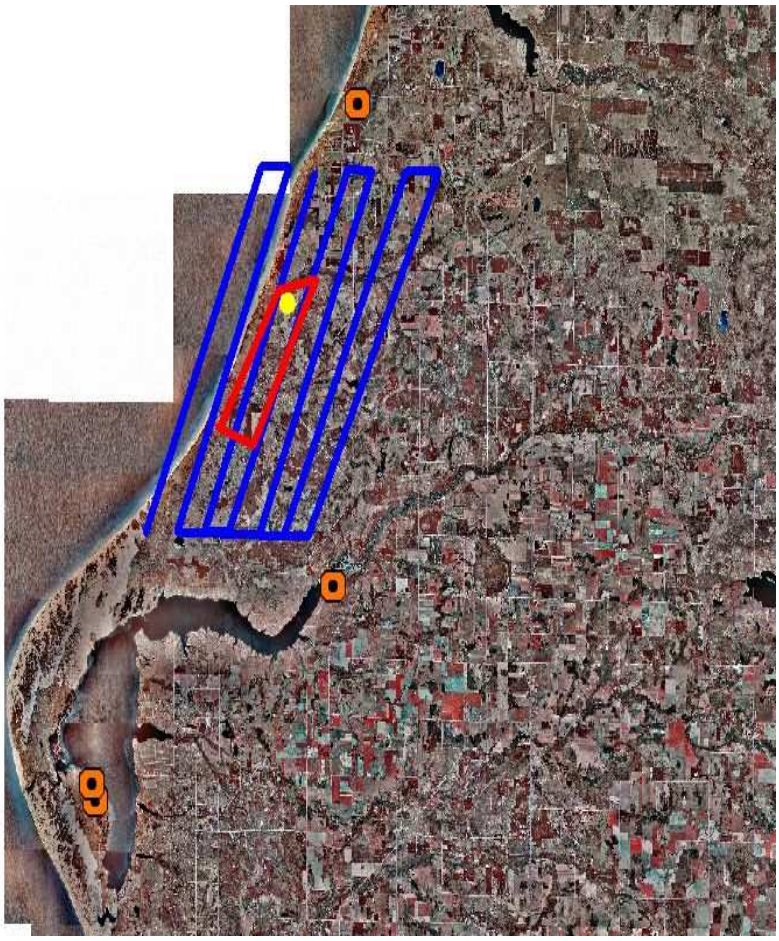

Figure 26. Aerial winter Bald Eagle surveys (blue) were conducted in February and March 2007 in Mason County, Michigan, near a site proposed for wind energy development (red). One Bald Eagle was observed (yellow). Surveys by the United States Forest Service detected Bald Eagle nests in 2006 and 2007 (orange).

Appendix A. List of bird species observed during bird surveys conducted in Mason County, Michigan, in and around a site proposed for wind energy development and a reference site. These sites were surveyed in April, May, June, September, October, and November 2007 for bird use.

Species[a]
Common Loon
Pied-billed Grebe
Double-crested Cormorant
Great Blue Heron
Tundra Swan
Canada Goose
Mallard
Wood Duck
Red-breasted Merganser
Turkey Vulture
Sharp-shinned Hawk
Red-tailed Hawk
Red-shouldered Hawk
Broad-winged Hawk
Rough-legged Hawk
Northern Harrier
Bald Eagle
American Kestrel
Ruffed Grouse
Wild Turkey
Sora
Sandhill Crane
Wilson's Snipe
Black-bellied Plover
Killdeer
Greater Yellowlegs
Upland Sandpiper
Herring Gull
Ring-billed Gull
Bonaparte's Gull
Mourning Dove
Yellow-billed Cuckoo
Black-billed Cuckoo
Barred Owl
Common Nighthawk
Chimney Swift
Belted Kingfisher

Appendix A (continued). List of bird species observed during bird surveys conducted in Mason County, Michigan, in and around a site proposed for wind energy development and a reference site. These sites were surveyed in April, May, June, September, October, and November 2007 for bird use.

Species[a]
Ruby-throated Hummingbird
Northern Flicker
Red-headed Woodpecker
Red-bellied Woodpecker
Hairy Woodpecker
Downy Woodpecker
Pileated Woodpecker
Yellow-bellied Sapsucker
Eastern Kingbird
Eastern Phoebe
Eastern Wood Pewee
Acadian Flycatcher
Alder Flycatcher
Least Flycatcher
Great-creasted Flycatcher
Yellow-bellied Flycatcher
Horned Lark
Tree Swallow
Barn Swallow
Blue Jay
American Crow
Common Raven
Black-capped Chickadee
Tufted Titmouse
White-breasted Nuthatch
Red-breasted Nuthatch
Brown Creeper
House Wren
Winter Wren
Brown Thrasher
Gray Catbird
American Robin
Eastern Bluebird
Hermit Thrush
Wood Thrush
Swainson’s Thrush
Gray-cheecked Thrush
Veery
Golden-crowned Kinglet

Appendix A (continued). List of bird species observed during bird surveys conducted in Mason County, Michigan, in and around a site proposed for wind energy development and a reference site. These sites were surveyed in April, May, June, September, October, and November 2007 for bird use.

Species[a]
Ruby-crowned Kinglet
Blue-gray Gnatcatcher
American Pipit
Bohemian Waxwing
Cedar Waxwing
Eastern Towhee
European Starling
Blue-headed Vireo
Red-eyed Vireo
Yellow-throated Vireo
Warbling Vireo
Black-and-white Warbler
Yellow-rumped Warbler
Black-throated Green Warbler
Black-throated Blue Warbler
Pine Warbler
Chestnut-sided Warbler
Magnolia Warbler
Nashville Warbler
Northern Parula
Common Yellowthroat
Canada Warbler
Palm Warbler
Yellow Warbler
Blackpoll Warbler
American Redstart
Ovenbird
Northern Waterthrush
Bobolink
Red-winged Blackbird
Baltimore Oriole
Common Grackle
Brown-headed Cowbird
Scarlet Tanager
Rose-breasted Grosbeak
Evening Grosbeak
Pine Grosbeak
Northern Cardinal
Indigo Bunting

Appendix A (continued). List of bird species observed during bird surveys conducted in Mason County, Michigan, in and around a site proposed for wind energy development and a reference site. These sites were surveyed in April, May, June, September, October, and November 2007 for bird use.

Species[a]
House Finch
American Goldfinch
Red Crossbill
Purple Finch
Common Redpoll
Pine Siskin
Eastern Towhee
Dark-eyed Junco
American Tree Sparrow
Vesper Sparrow
Chipping Sparrow
Field Sparrow
Song Sparrow
White-crowned Sparrow
White-throated Sparrow
Fox Sparrow
Lincoln's Sparrow
Swamp Sparrow
Snow Bunting
Lapland Longspur

[a] names of birds follow the *AOU Check-list of North American Birds*